4. Solvent Use

The use of solvents and other chemical products can result in emissions of various ozone precursors (i.e., criteria pollutants).[1] Nonmethane volatile organic compounds (NMVOCs), commonly referred to as "hydrocarbons," are the primary gases emitted from most processes employing organic or petroleum based solvents, along with small amounts of carbon monoxide (CO) and oxides of nitrogen (NO_x) whose emissions are associated with control devices used to reduce NMVOC emissions.

Although NMVOCs are not considered direct greenhouse gases, their role as precursors to the formation of ozone—which is a greenhouse gas—results in their inclusion in a greenhouse gas inventory. Emissions from solvent use have been reported separately by the United States to be consistent with the inventory reporting guidelines recommended by the IPCC. These guidelines identify solvent use as one of the major source categories for which countries should report emissions. In the United States, emissions from solvents are primarily the result of solvent evaporation, whereby the lighter hydrocarbon molecules in the solvents escape into the atmosphere. The evaporation process varies depending on different solvent uses and solvent types. The major categories of solvents uses include: degreasing, graphic arts, surface coating, other industrial uses of solvents (i.e., electronics, etc.), dry cleaning, and non-industrial uses (i.e., uses of paint thinner, etc.). Because many of these industrial applications also employ thermal incineration as a control technology, CO and NO_x combustion by-products are also reported with this source category.

Total emissions of nitrogen oxides (NO_x), nonmethane volatile organic compounds (NMVOCs), and carbon monoxide (CO) from 1990 to 1998 are reported in Table 4-1.

Table 4-1: Emissions of NO_x, CO, and NMVOC from Solvent Use (Gg)

Activity	1990	1991	1992	1993	1994	1995	1996	1997	1998
NO$_x$	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**NA**
Degreasing	+	+	+	+	+	+	+	+	NA
Graphic Arts	+	+	1	1	1	1	1	1	NA
Dry Cleaning	+	+	+	+	+	+	+	+	NA
Surface Coating	1	1	2	2	2	2	2	2	NA
Other Industrial Processes[a]	+	+	+	+	+	+	+	+	NA
Non-Industrial Processes[b]	+	+	+	+	+	+	+	+	NA
CO	**4**	**4**	**5**	**4**	**5**	**5**	**5**	**5**	**NA**
Degreasing	+	+	+	+	+	+	+	+	NA
Graphic Arts	+	+	+	+	+	+	+	+	NA
Dry Cleaning	+	+	+	+	1	1	1	1	NA
Surface Coating	+	1	1	1	1	1	1	1	NA
Other Industrial Processes[a]	4	3	3	3	3	3	3	3	NA
Non-Industrial Processes[b]	+	+	+	+	+	+	+	+	NA
NMVOCs	**5,217**	**5,245**	**5,353**	**5,458**	**5,590**	**5,609**	**5,569**	**5,672**	**NA**
Degreasing	675	651	669	683	703	716	604	623	NA
Graphic Arts	249	273	280	292	302	307	300	302	NA
Dry Cleaning	195	198	203	204	207	209	171	173	NA
Surface Coating	2,289	2,287	2,338	2,388	2,464	2,432	2,501	2,558	NA
Other Industrial Processes[a]	85	89	93	93	90	87	87	88	NA
Non-Industrial Processes[b]	1,724	1,746	1,771	1,798	1,825	1,858	1,906	1,928	NA

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[1] Solvent usage in the United States also results in the emission of small amounts of hydrofluorocarbons (HFCs) and hydrofluoroethers (HFEs), which are included under Substitution of Ozone Depleting Substances in the Industrial Processes chapter.

<superscript>a</superscript> Includes rubber and plastics manufacturing, and other miscellaneous applications.
<superscript>b</superscript> Includes cutback asphalt, pesticide application adhesives, consumer solvents, and other miscellaneous applications.
Note: Totals may not sum due to independent rounding.
+ Does not exceed 0.5 Gg

Methodology

Emissions were calculated by aggregating solvent use data based on information relating to solvent uses from different applications such as degreasing, graphic arts, etc. Emission factors for each consumption category were then applied to the data to estimate emissions. For example, emissions from surface coatings were mostly due to solvent evaporation as the coatings solidify. By applying the appropriate solvent emission factors to the type of solvents used for surface coatings, an estimate of emissions was obtained. Emissions of CO and NO_x result primarily from thermal and catalytic incineration of solvent laden gas streams from painting booths, printing operations, and oven exhaust.

Data Sources

The emission estimates for this source were taken directly from the EPA's *National Air Pollutant Emissions Trends, 1900-1998* (EPA 1999). Emissions were calculated either for individual categories or for many categories combined, using basic activity data (e.g., the amount of solvent purchased) as an indicator of emissions. National activity data were collected for individual applications from various agencies.

Activity data were used in conjunction with emission factors, which together relate the quantity of emissions to the activity. Emission factors are generally available from the EPA's *Compilation of Air Pollutant Emission Factors, AP-42* (EPA 1997). The EPA currently derives the overall emission control efficiency of a source category from a variety of information sources, including published reports, the 1985 National Acid Precipitation and Assessment Program emissions inventory, and other EPA data bases.

Uncertainty

Uncertainties in these estimates are partly due to the accuracy of the emission factors used and the reliability of correlations between activity data and actual emissions.